

EVALUATION OF THE FISH COMMUNITY AND GAME FISH POPULATIONS IN SUGAR CREEK (MONTGOMERY AND PARKE COUNTIES)

2000 Fish Management Report

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FISH POPULATIONS IN SUGAR CREEK
Montgomery and Parke Counties

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INTRODUCTION

Sugar Creek and its tributaries drain approximately 811 square miles of west central Indiana. The stream begins in the extreme southwest corner of Tipton County and flows to the southwest for nearly 90 miles before joining the Wabash River near Montezuma, Indiana.

The upper half of the creek flows through agricultural land and farming practices occur very close to the stream. Hence, the riparian zone is commonly fairly narrow along Sugar Creek and its tributaries which leads to increased siltation. In contrast, the creek downstream of Crawfordsville cuts through large tracts of forested land and meanders among high sandstone cliffs. Downstream of Crawfordsville, Sugar Creek flows through Shades State Park and Turkey Run State Park. Sugar Creek from Crawfordsville to Turkey Run is a popular area for canoeists.

The last fish community survey of Sugar Creek was conducted in 1994. During that survey, exceptional fish habitat was present that translated to high species diversity and a quality sport fishery. From 1991 to 1995, 53 streams similar in size to Sugar Creek were sampled throughout the state (Shipman 1997). By far, Sugar Creek ranked highest in species diversity with 71 species found with the next highest stream containing 61 species. Smallmouth and rock bass were the dominant game species in the central one-third of the stream, while catfish were most abundant downstream of Crawfordsville.

A 12 inch black bass size limit went into effect statewide in the summer of 1998. In an attempt to quantify the major sport fish populations in Sugar Creek and four other similar size streams and to evaluate the impacts of the size limit, a six-year study was initiated. Game fish population estimates were conducted at six sites on Sugar Creek in 1998. Similar to what was found on Sugar Creek in 1994, the sport fishery in 1998 east of Crawfordsville was composed primarily of smallmouth bass and rock bass and few catfish were present. West of Crawfordsville, channel and flathead catfish dominated, followed by lesser numbers of smallmouth, spotted, and rock bass. With the abundance of catfish downstream of Crawfordsville, the stream fish community more resembles a large river fishery rather than a small to medium size stream.

In 1998, an angler creel survey was conducted on nearly 45 miles of Sugar Creek from May through September. It was estimated that 76 angler days per mile took place during the

five month period. Overall there was an estimated 7,150 angler hours spent on the stream. Angler hours was twice as high upstream of Crawfordsville compared to hours west of Crawfordsville. The majority of the anglers encountered were fishing for smallmouth bass while few were seeking catfish. Rock bass was the most harvested species and all of those harvested were caught east of Crawfordsville. Black bass were the most caught fish from Sugar Creek. A total of 782 smallmouth were estimated harvested during the five month period of which nearly 80% came from upstream of Crawfordsville. An additional 3,667 black bass less than 12 inches long and 1,167 bass 12 inches or larger were caught and released. Catfish (channels and flatheads) harvest and release was fairly low, and oddly enough, more catfish were caught upstream of Crawfordsville compared to downstream which is opposite of what was found during the population estimates. Angling is not the only activity that takes place on Sugar Creek. It was estimated that nearly 27,000 user days were spent on the stream in activities such as canoeing, kayaking, tubing, and swimming. Over 99% of these activities took place downstream of Crawfordsville which is the area that three canoe liveries service.

In the summer of 2000, a fish community evaluation was conducted on Sugar Creek to compare diversity to the 1994 survey. In addition, another game fish population estimate was conducted in the fall of 2000 to see if population numbers and size structure had changed.

METHODS

FISH COMMUNITY EVALUATION

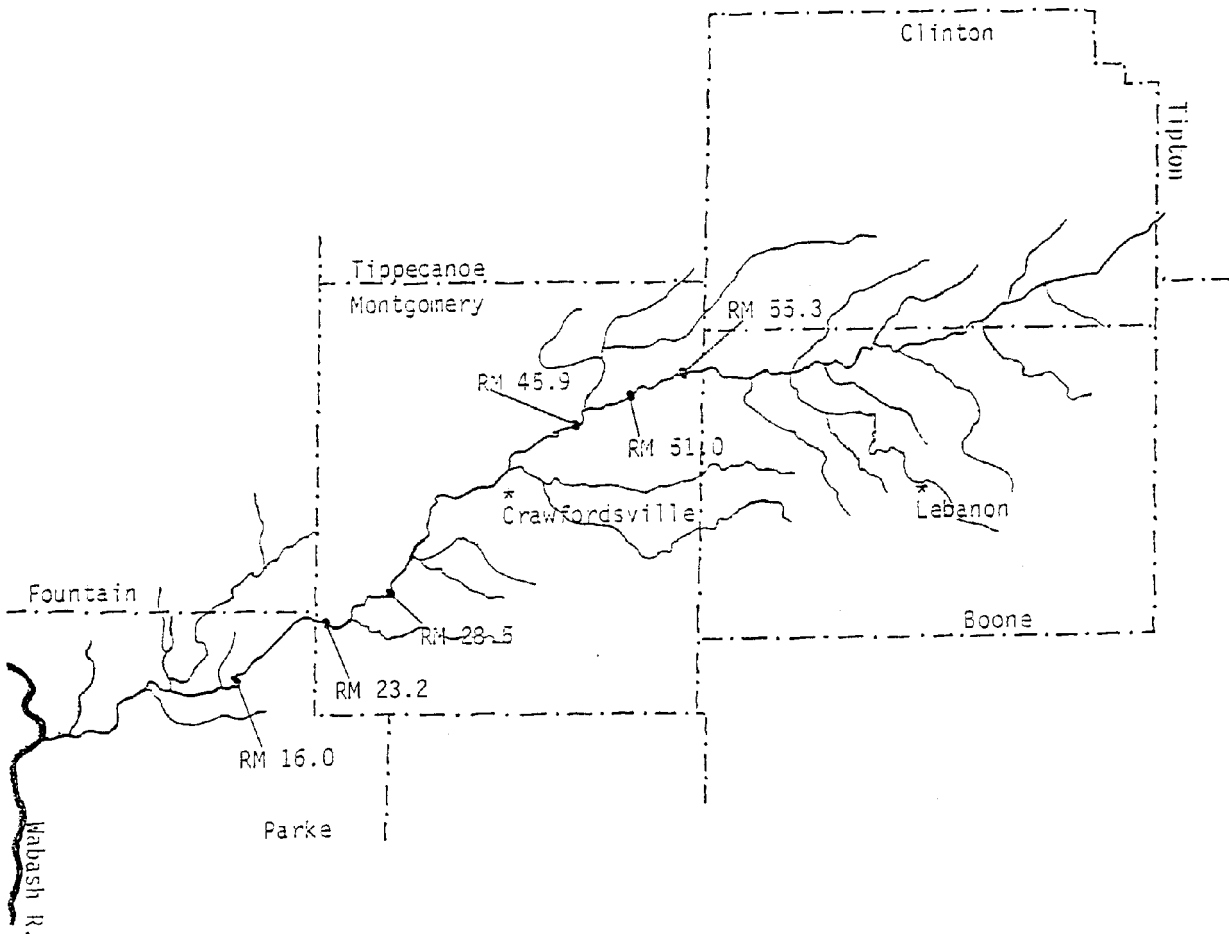
The fish community was evaluated at six stations on Sugar Creek from July 12 to August 16, 2000. Each station is referred to by river mile (RM). River mile is the number of miles the station is from Sugar Creek's confluence with the Wabash River. River mile and drainage area were determined from Hoggatt (1975). The stations sampled were the same as those surveyed during the 1998 population estimate. Stations at RM 16.0, RM 23.2, and RM 28.5 are all located downstream of Crawfordsville (Figure 1). From here on, this section of stream west of Crawfordsville will be referred to as the "Shades reach". Stations east of Crawfordsville were located at RM 45.9, RM 51.0, and RM 55.3. The stations upstream of Crawfordsville will be referred to as being in the "Darlington reach". A low-head dam in Crawfordsville forms the boundary between the two reaches.

All stations except RM 55.3 were sampled with a D.C. boat electrofisher during the day. Daytime D.C. barge electrofishing was conducted at RM 55.3. Boat sampling was conducted primarily in a downstream direction while the barge station was sampled in an upstream direction. An attempt was made to sample all habitat types provided water depth was

adequate. The boundaries of the stations nearly duplicated the 1998 population estimate boundaries. Since the stations are fairly short, sampling effort ranged from just over 0.4 hour to

nearly an hour for the boat stations and 0.36 hour for the barge station.

Figure 1. Sampling stations on Sugar Creek



An attempt was made by the three to four person crews to collect all fish observed. All fish were identified to species. Fish which could not be positively identified in the field were preserved in a 10% formalin solution and returned to the district office for identity verification. Game fish species such as the black bass, rock bass, and catfish were individually measured to the nearest 0.1 inch and weighed to the nearest 0.01 pound. Scale samples were collected from the black bass (smallmouth, largemouth, and spotted bass) and rock bass for age and growth analysis. Total numbers, total weights to the nearest 0.01 pound, and size ranges to the nearest 0.1 inch were determined for the remaining species.

Habitat was evaluated at all stations using a subjective scoring system known as the

Qualitative Habitat Evaluation Index (QHEI) which was developed by the Ohio Environmental Protection Agency (OEPA, 1989) and Rankin (1989). Stations were scored by observing bottom substrate, instream cover, channel morphology, riparian zone and bank erosion, pool/glide and riffle/run quality, and gradient. The maximum QHEI score is 100. Scores greater than 60 are considered good and indicate that a site has either not been modified or that it is recovering from past channel modification.

GAME FISH POPULATION ESTIMATES

Population estimates and community sampling were conducted at the same six stations sampled in 1998 and with the same gear used in 1998. Sampling occurred from September 18 to October 12, 2000 when the stream was low and clear. Length of the stations sampled was the same as 1998 for four of the stations. The station at RM 28.5 was shorter in 2000 due to extremely shallow water at the upper and lower ends of the station which hampered boat electrofishing. At RM 45.9, the station was shortened since it was difficult to get a reliable population estimate in 1998 due to the length of the station and the time that it took to sample the station.

An attempt was made to collect all black bass, rock bass, channel catfish, and flathead catfish observed. Both banks of the entire length of each station and any fish attracting cover in the middle of the stream channel were sampled four to five times in a single day in an effort to collect nearly all of the game fish from each station. Following an individual sampling run, collected fish were placed in a cage so they would not be collected in subsequent passes. The number of fish by species was counted and recorded for each sampling run. The population estimate of each species could then be determined for the reach based on declining catch rates for each pass. This method of population estimation is known as the "Depletion Method". Population estimates were calculated using a computer program developed by Van Deventer and Platts (1989). Each estimate was then expanded to represent the number of fish per mile of stream.

Collected fish were measured to the nearest 0.1 inch and weighed to the nearest 0.01 pound for fish less than 5 pounds and to the nearest 0.1 pound for larger fish. Scale samples were collected from the black bass and rock bass for age and growth determination. Finally, each fish was inspected for a fin clip (fins were clipped during the 1998 population estimate) and a fin was removed from each fish before it was released within the station boundaries. A fin was removed in order to determine recaptures during future samples and to determine movement of marked fish. Each station had a specific fin clip, however since there are only four possible fins to remove and six stations were sampled, two clips had to be repeated. The

fin clips for each station were: RM 16.0, left pectoral; RM 23.2, left ventral; RM 28.5, right ventral; RM 45.9, right pectoral; RM 51.0, left pectoral; RM 55.3, left ventral.

STATION DESCRIPTIONS

The station at RM 16.0 was located just upstream of Turkey Run State Park in Parke County. Two shallow riffles formed the station boundaries of the 700 foot long station. Maximum depth of the station was 7.5 feet and excellent habitat was present (QHEI score of 78.5). Instream cover was composed primarily of huge boulders that were fractured from the rock wall that borders the station. During the community survey, electrofishing effort was 25 minutes. Five passes were made through the station during the population estimate that averaged 22 minutes each.

Within the boundaries of Shades State Park was the station at RM 23.2 in Montgomery County. It took 24 minutes to cover the 1,135 foot station during the community sample. For the population estimate, four passes were made through the station that averaged 25 minutes per run. The station was relatively shallow, however, there was a fair amount of water 4 feet or deeper. Quality fish habitat was present (QHEI score of 72) and instream cover was primarily composed of enormous boulders that had broken away from the adjacent rock wall.

Davis bridge in Montgomery County is the location of the station at RM 28.5. This station contained the poorest fish habitat of the six stations surveyed (QHEI score of 67), however the habitat is still considered good by QHEI standards. Habitat at this station ranked poorer than the others because of substrates consisting primarily of sand and gravel, shallow depth, and limited instream cover. The station was 2,035 feet long for the community sample. Extremely shallow water in the fall forced the station to be cut to 1,735 feet. Four passes were made through the station during the population estimate that averaged 24 minutes per run.

The first station upstream of Crawfordsville was located at RM 45.9. This station had the second highest QHEI score (78.0) and had the deepest average depth (3.7 feet) of any of the stations sampled. Approximately 2,640 feet of stream was sampled during the July sample, but the station was reduced in the fall to 1,760 feet in order to achieve a more reliable population estimate. Four runs were made through this reach during the population estimate that averaged 27 minutes per pass.

The station at RM 51.0 was located just north of Darlington in Montgomery County. Excellent fish habitat is present in this area (QHEI score of 75.5) but much of the station is very shallow. The length of the station for the community evaluation was 1,376 feet while the station was 971 feet for the population estimate (same distance as the 1998 population estimate). Four runs that averaged 23 minutes each were made during the population

estimate.

The uppermost area sampled was located at RM 55.3 and was the only station that was sampled with the D.C. barge electrofisher since most of the station was very shallow. High quality fish habitat was present at this station (QHEI score of 77) and there were very stable substrates primarily composed of bedrock and slab rock. This station was 940 feet in length. During the population estimate, four passes were made that averaged 14 minutes per run.

RESULTS

FISH COMMUNITY EVALUATION

A total of 1,355 fish was collected which represented 33 species and eight families (Appendix A). Nearly 1,050 pounds of fish were sampled. Individual station descriptions, fish collections, and QHEI scores are located in Appendix B. In 1994, 71 species were collected. Species diversity was higher in 1994 because 14 stations were sampled twice, once in the spring and once in the summer/fall. In addition, 12 of the 14 stations in 1994 were sampled with the barge electrofisher which is far more effective at collecting small non-game species from riffles compared to the boat electrofisher.

The sucker family was the most abundant family collected by both number (57.7%) and weight (46.6%). A total of 782 suckers was collected that weighed 489.58 pounds and was represented by seven species. Black redhorse, golden redhorse, and northern hog sucker were the dominant sucker species and all ranked within the top four species for the total collection. Most suckers require quality riffles for spawning.

Two hundred and seventy-nine members of the sunfish family were collected that weighed nearly 56 pounds. The sunfish family ranked second in abundance by number (20.6%) and fourth by weight (5.3%). Longear sunfish was the most abundant member of the family and ranked third in the total sample. Forty-five rock bass were sampled that ranged from 4.6 to 8.9 inches long. Over 84% of the rock bass came from the Darlington reach. Smallmouth bass up to 17.0 inches long were collected. Of the 37 smallmouth collected, 28 of them were found in the three stations in the Darlington reach. Other members of the sunfish family collected include largemouth bass, white crappie, and bluegill.

A total of 166 members of the minnow family was collected which placed them third in abundance by number in the survey (12.3%). This family was represented by nine species. Central stoneroller, common carp, and spotfin shiner were the most numerous species from the minnow family. Collectively, the minnow family weighed approximately 297 pounds which placed them second in abundance by number (28.3%). Common carp was the most abundant

species collected by weight in the entire survey (28.1%). Carp comprised over 99% of the weight of the minnow family. The small members of the minnow family were likely greatly under sampled in the present survey since most of the stations were sampled with the boat. The majority of the minnows collected were sampled at the single barge station and seven of the nine species were also collected at this station. In 1994, 24 minnow species were collected and minnows comprised nearly 43% of the collection by number.

The fourth most abundant family by number (4.7%) and third by weight (17.7%) was the catfish family. Sixty-four catfish were collected which weighed nearly 186 pounds. Thirty-two flathead catfish that ranged in length from 8.5 to 31.8 inches were sampled. All but one of the flatheads collected were found at the three stations in the Shades reach. Channel catfish up to 24.8 inches long were collected. Twenty-two of the 24 channels collected came from the Shades reach. Yellow bullhead and stonecat were the only other species collected from the catfish family.

Thirty-five gizzard shad that weighed 12.78 pounds were collected. Shad ranged in length from 7.3 to 14.0 inches. All of the shad sampled came from the three stations downstream of Crawfordsville.

The perch family was represented by three small species: greenside darter, rainbow darter, and blackside darter. Seventeen darters were collected. Not only the numbers of darters, but also the number of species was considerably less than what was observed in 1994. Most darters are found in shallow riffles which are ineffectively sampled with a boat electrofisher. Eight darter species were found in 1994, but the barge was utilized to sample most of the stations that year. In the present survey, two of the three species and fifteen of the seventeen individuals were collected from the single barge station.

Freshwater drum is the only species of the drum family found in Indiana. Ten drum were sampled that collectively weighed nearly 5 pounds. Drum, which are frequently sought by anglers, ranged from 6.9 to 13.5 inches long. All of the drum were found downstream of Crawfordsville.

A single longnose gar and one shortnose gar rounded out the collection. Gar ranged in length from 22.3 to 28.5 inches. Gar are usually found in larger rivers, so it is not surprising that both individuals were found in the Shades reach.

GAME FISH POPULATION ESTIMATES

Smallmouth bass

The most numerous species collected in the population estimates was smallmouth bass. A total of 366 smallmouth that weighed nearly 171 pounds was collected. The average

population estimate for all stations surveyed was 362 smallmouth per mile, however, the two reaches had vastly different population estimates (Table 1). The smallmouth population averaged 532 per mile in the Darlington reach and just 192 per mile in the Shades reach. The highest populations were found at RM 51.0 (875 per mile) and RM 55.3 (511 per mile). In 1998 the overall average of the population estimates was just 112 smallmouth per mile. The 2000 smallmouth estimates were 3.5 times higher than 1998 in the Darlington reach and 4.3 times higher in the Shades reach. While the population may have increased somewhat since 1998, the timing of the sampling may have been more responsible for the nearly tripled population in the present survey compared to 1998. In 1998, the population estimates were conducted in mid summer as opposed to fall sampling in 2000. It was suspected that during the summer samples in 1998, the fish were in the deepest water available in an area. Since electrofishing gear is not very effective in water deeper than four feet, the fish were probably under sampled in 1998. In the fall when the water cools, game fish are more likely to move into shallow water that can be effectively sampled.

Table 1. Game fish population estimates (number per mile) for each station surveyed on Sugar Creek in the fall of 2000.

Station	Smallmouth bass	Largemouth bass	Spotted bass	Rock bass	Channel catfish	Flathead catfish
RM 16.0	83	60	106	68	68	219
RM 23.2	237	84	37	270	730	60
RM 28.5	256	27	0	43	113	79
RM 45.9	210	75	0	219	0	15
RM 51.0	875	109	0	82	11	0
RM 55.3	511	6	0	326	0	22
Avg. Shades reach	192	57	48	127	304	119
Avg. Darlington reach	532	63	0	209	4	12
Overall Avg.	362	60	24	168	154	66

Smallmouth ranged from 2.8 to 20.5 inches long (Table 2). The average smallmouth bass captured in the Darlington reach measured 7.5 inches long while the Shades reach smallmouth averaged 10.4 inches. Overall, nearly 21% of the smallmouth collected were 12 inches or larger which is nearly identical to that observed in 1998. However, 38% of the Shades reach smallmouth were 12 inches compared to 12% in the Darlington reach which is

also nearly identical to 1998. The most represented year class of smallmouth collected was spawned in 1999, followed by the 1997 year class. The spring and summers of 1997 and 1999

Table 2. Length frequency, average weights, and age of smallmouth bass collected from Sugar Creek in the fall of 2000.

Length (in.)	RM 16.0	RM 23.2	RM 28.5	RM 45.9	RM 51.0	RM 55.3	TOTAL	Avg. Weight	Age
3.0		1		1			2	0.02	YOY
3.5		2					2	0.03	YOY
4.0		3			1		4	0.03	YOY
4.5	1				10	1	12	0.04	YOY,1
5.0	1	1		3	16	6	27	0.05	YOY,1
5.5		1		11	11	6	29	0.07	YOY,1
6.0			3	14	11	15	43	0.09	1
6.5	2		10	14	12	7	45	0.12	1
7.0		1	8	8	5	5	27	0.14	1
7.5		3	12	4	5	10	34	0.17	1
8.0	1	2	3	2	4	1	13	0.21	1
8.5		4	5	2	2	3	16	0.27	1
9.0			2	1	3	2	8	0.29	1,2
9.5		4		1	2		7	0.40	1,2
10.0			1		3	2	6	0.42	1,2,3
10.5	1	1	1		2		5	0.49	1,2,3
11.0	1		3	3		2	9	0.57	1,3
11.5					1		1	0.55	3
12.0	1		3		7	1	12	0.74	2,3
12.5		2	2		1	3	8	0.88	2,3,4
13.0		1	2		1		4	0.92	3
13.5			2		1		3	1.10	3,4,6
14.0		1	1	1			3	1.23	4,5
14.5		1	2		2		5	1.39	3,4,5
15.0		1	5		1	1	8	1.57	4,5,6
15.5		2	2		1	1	6	1.77	4,5,6
16.0	1	1	2		1		5	1.89	4,5,6
16.5		1	4		1	1	7	2.00	5,6
17.0		1				1	2	2.39	5
17.5		1	2		3		6	2.57	5,6,8
18.0	1						1	2.90	4
18.5		1	1				2	3.09	6
19.0						1	1	3.50	Not aged
19.5		1	1				2	3.74	7
20.5	1						1	4.77	8
TOTAL	11	37	77	65	107	69	366		

were both relatively dry which is conducive to the best bass spawns in streams. As observed in 1998, the smallmouth aged in the present survey are growing considerably slower in the Darlington reach compared to the Shades reach (Appendix C). At age 2, smallmouth in the Shades reach are 1.1 inches larger than age 2 Darlington reach fish. Darlington reach smallmouth are 1.5 inches shorter than Shades reach fish at age 3. Shades reach smallmouth are reaching 12 inches long in just over three years while it is taking Darlington reach fish over four years to reach 12 inches. Compared to smallmouth growth in other central Indiana streams, growth is normal for smallmouth in the Darlington reach and above normal in the Shades reach. The higher density of smallmouth in the Darlington reach is likely the reason for the slower growth.

Largemouth bass

Largemouth bass was the next most abundant of the black bass species collected with an average population estimate of 60 per mile. Largemouth were nearly equally distributed throughout the stream as the Darlington reach averaged 63 per mile while the Shades reach averaged 57 per mile. On average, the population estimate was only four largemouth per mile in 1998. Flowing water is not preferred habitat for largemouth bass, so their low population numbers compared to smallmouth numbers is not surprising. Seventy-five largemouth were sampled in the present survey that collectively weighed 27.60 pounds. Largemouth up to 13.6 inches long were found with the average fish measuring 8.4 inches (Table 3). Five of the largemouth were 12 inches or larger. Over half of the largemouth bass collected were spawned in 1999 and a decent year class was spawned in 2000.

Spotted bass

Spotted bass were collected only from RM 16.0 and RM 23.2. At RM 16.0, spotted bass had the highest population of all of the three black bass species (106 per mile). Spotted bass generally replace smallmouth in larger Indiana streams since spotted bass can tolerate warmer water and lower gradient. Twenty-two spotted bass that ranged from 6.7 to 15.6 inches long were collected (Table 4). Nearly all of the spotted bass collected were from the 1999 year class.

Table 3. Length frequency, average weights, and age of largemouth bass collected from Sugar Creek in the fall of 2000.

Length (in.)	RM 16.0	RM 23.2	RM 28.5	RM 45.9	RM 51.0	RM 55.3	TOTAL	Avg. Weight	Age
3.0						1	1	0.01	YOY
3.5			1	2	2		5	0.02	YOY
4.0				3			3	0.04	YOY
4.5				1			1	0.04	YOY
5.0	1	1		2	1		5	0.06	YOY
5.5	2	4		1			7	0.09	YOY
6.0		2					2	0.09	YOY
7.5					1		1	0.17	1
8.0		1			1		2	0.24	1
8.5					3		3	0.27	1
9.0			1	1	1		3	0.35	1
9.5			2	1	3		6	0.38	1
10.0	1	2	1	4	1		9	0.42	1
10.5	2	4	2	6	3		17	0.56	1
11.0	2		1		2		5	0.66	1,2
12.0			1	1			2	0.85	2
12.5				1	1		2	0.97	2
13.5				1			1	1.29	2
TOTAL	8	14	9	24	19	1	75		

Table 4. Length frequency, average weights, and age of spotted bass collected from Sugar Creek in the fall of 2000.

Length (in.)	RM 16.0	RM 23.2	RM 28.5	RM 45.9	RM 51.0	RM 55.3	TOTAL	Avg. Weight	Age
6.5		1					1	0.14	1
7.0	1	3					4	0.16	1
7.5	3	2					5	0.19	1
8.0	1	1					2	0.22	1
8.5	1						1	0.27	1
9.0	3	1					4	0.35	1
9.5	2						2	0.39	1,2
12.5	1						1	1.01	3
13.0	1						1	1.16	3
15.5	1						1	1.93	6
TOTAL	14	8	0	0	0	0	22		

Rock bass

Overall, rock bass averaged 168 per mile, however, their population was far higher in the Darlington reach (209 per mile) than in the Shades reach (127 per mile). In 1998, the Darlington reach averaged 115 rock bass per mile and the Shades reach averaged 27 per mile. Once again, the higher populations observed in the present survey were likely due in part to the change in survey timing. Two hundred and eighteen rock bass were collected that weighed 38.67 pounds. Rock bass were collected up to 9.1 inches long and averaged 6.0 inches (Table 5). Over 62% of the rock bass collected were 6 inches or larger and nearly 11% were 8 inches or longer.

Table 5. Length frequency, average weights, and age of rock bass collected from Sugar Creek in the fall of 2000.

Length (in.)	RM 16.0	RM 23.2	RM 28.5	RM 45.9	RM 51.0	RM 55.3	TOTAL	Avg. Weight	Age
2.0						2	2	<0.01	YOY
2.5						1	1	0.01	1
3.0									
3.5				5		11	16	0.03	1
4.0		4	1	4		5	14	0.04	1
4.5	2	3		4	1		10	0.07	1
5.0	3	14		3			20	0.09	1
5.5	2	10		5	1	1	19	0.11	1,2,3
6.0		7		13	2	5	27	0.16	1,3
6.5		7	4	17	3	7	38	0.19	1,2,3
7.0		3	1	7	6	7	24	0.24	2,3,5
7.5	1	3	3	9		8	24	0.29	3,4,5,6
8.0	1	1	4	1	2	5	14	0.36	3,4,5
8.5		2	1	1		3	7	0.41	4,5
9.0				2			2	0.55	5
TOTAL	9	54	14	71	15	55	218		

Growth of rock bass is slower in the Darlington reach than in the Shades reach. In the Shades reach, rock bass average 7.7 inches long at age 4. However, it takes an additional year for rock bass in the Darlington reach to achieve that same length. Despite the differences in growth, rock bass in both reaches are growing above normal compared to other central Indiana rock bass populations. Like smallmouth bass, most of the rock bass collected were spawned in 1997 and 1999.

Channel catfish

A total of 147 channel catfish was collected that weighed 151.32 pounds. Very few

channels were collected in the Darlington reach (average 4 per mile) while the Shades reach averaged 304 per mile. The station at RM 23.2, which is within Shades State Park, had a population estimate of 730 channel catfish per mile which was the highest observed. Only one station in the Darlington reach contained channel catfish. In 1998, channel catfish averaged 219 per mile in the Shades reach and 13 per mile in the Darlington reach.

Channel catfish ranged in length from 4.8 to 23.5 inches (Table 6). The average channel collected measured 14.3 inches long. Over 14% of the channel catfish sampled were 18 inches or longer in the present survey compared to 18% in 1998.

Table 6. Length frequency and average weights of channel catfish collected from Sugar Creek in the fall of 2000.

Length (in.)	RM 16.0	RM 23.2	RM 28.5	RM 45.9	RM 51.0	RM 55.3	TOTAL	Avg. Weight
5.0		4					4	0.04
6.0		1	1				2	0.05
8.0		2	1				3	0.12
8.5		2	2				4	0.14
9.0		1					1	0.16
9.5		4	1				5	0.21
10.0		1					1	0.22
10.5		5	2				7	0.30
11.5	1	1	2				4	0.39
12.0		3					3	0.45
12.5	1	7					8	0.50
13.0	1	9					10	0.62
13.5	1	6	1				8	0.66
14.0	2	5	1				8	0.78
14.5		5	2				7	0.87
15.0	1	7	1				9	0.93
15.5		10	4				14	1.08
16.0	1	7	3				11	1.17
16.5		4	1				5	1.37
17.0	1	3	3				7	1.54
17.5		4	1				5	1.59
18.0		4	1				5	1.82
18.5		2					2	1.81
19.5		2	4				6	2.21
20.0			1				1	2.64
20.5		1	1				2	2.75
21.0		1					1	3.15
21.5		1					1	3.78
22.5		1			1		2	4.33
23.5					1		1	4.22

TOTAL	9	103	33	0	2	0	147
<u>Flathead catfish</u>							

Flathead catfish were collected at five of the six stations. However, as with channel catfish, flatheads were far more abundant in the Shades reach (119 per mile) than in the Darlington reach (12 per mile). In 1998, flatheads averaged 64 per mile in the Shades reach and 4 per mile in the Darlington reach. In the present survey, the highest estimate occurred at RM 16.0 (219 per mile) which is the furthest downstream station.

Seventy-two flatheads were sampled that collectively weighed 421.26 pounds. The largest flathead captured in the Darlington reach measured 32.1 inches long while the biggest in the Shades reach was 35.1 inches long (Table 7). The heaviest flathead weighed over 22 pounds. The average flathead sampled measured 20.6 inches long. Twelve of the flatheads caught were 30 inches or larger. A fairly uniform size distribution of flathead catfish was observed which indicates successful reproduction in most years.

MOVEMENT OF MARKED FISH

The species of fish most often encountered that had a fin clip from the 1998 sampling was channel catfish. In 1998, 65 channels were marked at RM 23.2. In the present surveys, seven of the channel catfish captured at this station had a fin clip and all of them had the clip that indicated that they had been captured at that station two years earlier (Table 8). Seven channel catfish at RM 28.5 had a right ventral fin clip that shows they were captured in the same area in 1998. No channels marked at one station showed up at another station.

In 1998, 39 flathead catfish were collected and marked. In the present surveys, twelve marked flatheads were found. In 1998, the only flathead captured at RM 45.9 measured 21.5 inches long. In the present survey, one of the five flatheads captured from this station had a clip and it was the same one caught two years prior from this station. This fish grew 8.5 inches and gained nearly seven pounds in two years. Five marked flatheads were collected at RM 16.0. Four of the five had marks indicating that they had originally been sampled from this station while the other had been marked seven miles upstream two years prior. Five flatheads marked at RM 23.2 in 1998 were again caught at the same station in 2000. One flathead originally fin clipped at RM 28.5 was again found at that same station in 2000. Of the recaptured flathead catfish collected, all were adults that ranged from 23.0 to 34.9 inches long.

Nine smallmouth bass possessed fin clips and all but one were collected at the same station that they were originally marked at. The only exception was a 12.7 inch smallmouth collected at RM 28.5 during the community sampling in 2000 that had originally been marked five miles downstream two years earlier. Most of the smallmouth bass that remained in the

same area were large adults.

Table 7. Length frequency and average weights of flathead catfish collected from Sugar Creek in the fall of 2000.

Length (in.)	RM 16.0	RM 23.2	RM 28.5	RM 45.9	RM 51.0	RM 55.3	TOTAL	Avg. Weight
6.0						1	1	0.06
6.5	1	1					2	0.10
7.0						1	1	0.13
7.5		1	1			2	4	0.15
8.0	1						1	0.15
8.5			1				1	0.20
9.0		1					1	0.32
9.5		1					1	0.28
10.0	2	1	2				5	0.34
10.5			1				1	0.41
11.5		1					1	0.52
12.0	1	1					2	0.67
12.5			1				1	0.63
13.5	1		1				2	0.90
18.0		1	1				2	2.28
18.5	1						1	2.41
19.0			1				1	2.60
19.5	1		1				2	3.09
20.0			1				1	2.98
20.5			2	1			3	3.52
21.5	1						1	4.41
22.5	2						2	5.65
23.5	1						1	6.70
24.0			2				2	5.08
24.5			1				1	5.00
25.0	1		1				2	7.35
25.5	2		3				5	7.18
26.0	1	1	1				3	7.53
26.5	1	1	1				3	8.67
27.0	1						1	8.60
28.5	2			1			3	11.03
29.0	1		1				2	11.20
30.0	1			1			2	11.85
31.0	1			1			2	12.75
31.5	1						1	15.10
32.0				1			1	14.00
33.5	1						1	15.40
34.0	2						2	15.60
34.5	1						1	18.20
35.0	1		1				2	19.85
TOTAL	29	10	24	5	0	4	72	

Table 8. Location and length of fin clipped fish collected in 2000 (during both the community sampling and the population estimates) and the location where they were marked in 1998.

Species	Location where collected in 2000	Length (inches)	Location where originally marked
Channel catfish	RM 23.2	21.4	RM 23.2
	RM 23.2	19.3	RM 23.2
	RM 23.2	17.8	RM 23.2
	RM 23.2	15.7	RM 23.2
	RM 23.2	15.7	RM 23.2
	RM 23.2	14.5	RM 23.2
	RM 23.2	12.8	RM 23.2
	RM 28.5	19.8	RM 28.5
	RM 28.5	19.3	RM 28.5
	RM 28.5	18.1	RM 28.5
	RM 28.5	17.1	RM 28.5
	RM 28.5	17.1	RM 28.5
	RM 28.5	16.6	RM 28.5
	RM 28.5	15.4	RM 28.5
Flathead catfish	RM 16.0	34.9	RM 16.0
	RM 16.0	33.4	RM 16.0
	RM 16.0	31.8	RM 16.0
	RM 16.0	31.7	RM 16.0
	RM 16.0	28.4	RM 23.2
	RM 23.2	28.6	RM 23.2
	RM 23.2	26.7	RM 23.2
	RM 23.2	26.1	RM 23.2
	RM 23.2	26.0	RM 23.2
	RM 23.2	23.0	RM 23.2
	RM 28.5	25.4	RM 28.5
	RM 45.9	30.1	RM 45.9
Smallmouth bass	RM 23.2	16.3	RM 23.2
	RM 28.5	12.7	RM 23.2
	RM 51.0	17.6	RM 51.0
	RM 51.0	10.7	RM 51.0
	RM 51.0	9.9	RM 51.0
	RM 55.3	17.2	RM 55.3
	RM 55.3	17.0	RM 55.3
	RM 55.3	16.7	RM 55.3
Rock bass	RM 55.3	15.1	RM 55.3
	RM 23.2	7.7	RM 28.5
	RM 23.2	4.2	RM 23.2
	RM 55.3	8.1	RM 55.3
	RM 55.3	7.8	RM 55.3
Largemouth bass	RM 55.3	6.3	RM 55.3
	RM 16.0	10.4	RM 16.0
	RM 45.9	8.3	RM 51.0
Spotted bass	RM 16.0	9.2	RM 28.5

Five marked rock bass were sampled. One moved five miles downstream while the others remained in the same area they were marked at in 1998. One largemouth remained in the same area that it had been marked while one moved from RM 51.0 in 1998 to RM 45.9 in 2000. The recaptured fish that made the furthest migration was a 9.2 inch spotted bass that was collected at RM 16.0 in the present survey but had been marked at RM 28.5 in 1998.

CONCLUSIONS

Recently, Sugar Creek has ranked as one of Indiana's top streams in terms of species diversity and sport fish populations. Although far fewer species were collected during the present fish community evaluation compared to 1994, diversity is likely very similar to that observed in 1994. Additional species of minnows and darters would have been collected had more of the stations been sampled with the barge electrofisher. Also, the 1994 survey covered about 75 miles of stream while the present sampling covered less than 40 miles of stream. In a stream the length of Sugar Creek, fish community assemblages are vastly different in the upper area compared to the lower reach.

As observed in previous surveys, the sport fishery in the upper and lower reaches of Sugar Creek are quite different. Upstream of Crawfordsville, black bass and rock bass densities averaged 804 per mile while in the Shades reach the density was 424 per mile. Catfish densities averaged 423 per mile downstream of Crawfordsville but just 16 per mile in the Darlington reach. Smallmouth bass and rock bass are growing somewhat slower in the Darlington reach, probably because of the higher density populations.

Population estimates were far higher for all species in the present survey compared to 1998. The overall smallmouth estimate per mile better than tripled the 1998 estimate, rock bass more than doubled, flathead catfish was twice as high, and the channel catfish population was about 50% higher than in 1998. Some of the dramatic increase for especially smallmouth and rock bass was due to the fact that two of the previous three spawns produced very successful year classes (1997 and 1999). Low spring and summer flows in those years were conducive to extremely successful reproduction and recruitment. For the 1998 sampling, the only noticeably dominant year class of smallmouth bass was spawned in 1997. Another major factor that likely contributed to the considerably higher population estimates for all species was the change in the timing of the sampling. All of the game species seem to be far more vulnerable to electrofishing in streams once the water temperature cools since fish are not as apt to be in the deep pools.

The size structure of smallmouth bass is very similar that observed in 1998 as the average size and percent of harvestable size fish are nearly identical. However, the proportion of smallmouth over 14 inches long is up from 7% in 1998 to 13% in 2000. Less than 2% of the

smallmouth bass were 17 inches or larger in 1998 compared to 4% in 2000. The average size rock bass collected and the percent harvestable were very similar over the two year period. Catfish size structures are also very comparable from 1998 to 2000.

High species diversity and quality sport fish populations are a reflection of excellent fish habitat and good water quality. In most areas of Sugar Creek, the stream channel contains stable substrates and fairly low levels of silt, a good diversity of instream cover primarily composed of boulders, woody debris, and deep pools, and well developed pool/riffle/run complexes.

Population estimates will again be conducted at the same six Sugar Creek stations in the fall of both 2002 and 2004. Once again these surveys will focus on changes in the sport fish populations and the changes in size structure of those populations.

An interesting aspect of the present survey was to observe fish movement. In 1998, a total of 160 channel catfish were collected and marked. In 2000, 14 marked channel catfish were found and all were in the same location that they were marked two years prior. Of the 39 flatheads marked in 1998, twelve of them were again captured in 2000. All but one of the flatheads remained in the same station that they were originally marked. Of the nine fin clipped smallmouth sampled, only one had moved to another of the sampling stations. Four of the five marked rock bass were found in the same station that they had initially been fin clipped.

The best fishing opportunities throughout the stream would be for smallmouth and rock bass. Nearly 21% of the smallmouth collected were at or larger than the 12 inch minimum size limit for black bass and the majority of the rock bass were over 6 inches long. Anglers seeking larger smallmouth bass to catch should concentrate their efforts downstream of Crawfordsville, while those who are looking for higher numbers of smallmouth to catch should fish upstream of Crawfordsville. While there is a five fish black bass bag limit, anglers are encouraged to practice catch and release. This would maintain abundant broodstock populations that could reproduce successfully in years that have low spring and summer stream flows. Another reason anglers are encouraged to release their fish is that there is a fish consumption advisory for part of Sugar Creek. The 2000 Indiana Fish Consumption Advisory recommends that no fish be eaten that are taken from Interstate 74 downstream to State Road 32 due to high PCB levels (Indiana State Department of Health, 2000). There are other recommended consumption restrictions for Sugar Creek downstream of State Road 32 listed in the consumption advisory booklet which is updated annually. Channel and flathead catfish anglers should definitely fish in the Shades reach, seeking deep holes, especially if those deep holes contain cover in the form of boulders or woody debris. There is a 10 inch minimum size limit for catfish in streams.

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APPENDIX B.

Individual station descriptions, fish collections, and habitat evaluations for the stations surveyed on Sugar Creek in the summer of 2000.

APPENDIX C.

Average back calculated lengths of selected game fish
species collected from Sugar Creek in 2000.